2.2 Physical Environment

2.2.1 Hydrology and Floodplains

2.2.1.1 Regulatory Setting

EO 11988 (Floodplain Management) directs all federal agencies to refrain from conducting, supporting, or allowing actions in floodplains unless it is the only practicable alternative. FHWA requirements for compliance are outlined in 23 CFR 650 Subpart A.

To comply, the following must be analyzed:

- The practicability of alternatives to any longitudinal encroachments.
- Risks of the action.
- Impacts on natural and beneficial floodplain values.
- Support of incompatible floodplain development.
- Measures to minimize floodplain impacts and to preserve/restore any beneficial floodplain values affected by the project.

The base floodplain is defined as "the area subject to flooding by the flood or tide having a 1 percent chance of being exceeded in any given year." An encroachment is defined as "an action within the limits of the base floodplain."

2.2.1.2 Affected Environment

This section has been prepared based on the analysis and findings presented in the following technical studies:

- *Floodplain Evaluation Report* (January 2016)
- *Preliminary Hydraulics Report for Bridge No. 55-0451* (October 2016)
- *Preliminary Hydraulics Report for Bridge No. 55-0285* (October 2015)
- *Preliminary Drainage Report* (October 2015)

Hydrologic Setting

The topography is relatively flat and slopes gradually in the southwesterly direction, with gentle slopes averaging 1 to 3 percent.

The *Orange County Hydrology Manual* (1986) uses a system developed by the NRCS that classifies soils into four different hydrologic soil groups. These NRCS soil classifications are further described below.

- *Group A* – Low runoff potential. Soils having high infiltration rates even when thoroughly wetted and consisting chiefly of deep, well-drained sands or gravels. These soils have a high rate of water transmission.
- *Group B* – Soils having moderate infiltration rates when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well to well drained sandy-loam soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.
- *Group C* – Soils having slow infiltration rates when thoroughly wetted and consisting chiefly of silty-loam soils with a layer that impedes downward movement of water, or soils with moderately fine to fine texture. These soils have a slow rate of water transmission.
- *Group D* – High runoff potential. Soils having very slow infiltration rates when thoroughly wetted and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission.

Soils within the project limits are identified as Hydrologic Soil Groups B, C, and D.

The climate of the project area in Orange County, California is classified as Mediterranean, which is characterized by warm, dry summers and mild, wet winters. Coastal areas have a moderate climate with frequent fog in the summer. Most of the precipitation comes as rain during the winter months from December through February. The annual average rainfall within the project area is approximately 13 inches. The major contributions to the climate are the Eastern Pacific High and the moderating effects of the Pacific Ocean. The mean winter high temperature is 65 degrees Fahrenheit (°F), and the mean high summer temperature is 77°F. On average, Orange County experiences 328 days of sunshine per year and an average daytime temperature of 73°F.

Floodplains

The Federal Emergency Management Agency (FEMA) designates Special Flood Hazard Areas (SFHAs) according to zones. The Base Flood Elevation (BFE) is the water-surface elevation of the 1 percent annual chance of flood. The zones are described as:

Zone A – Corresponds to the 100-year floodplains that are determined in the Flood Insurance Study (FIS) by approximate methods. No BFEs or depths have been determined.

Zone AE – Corresponds to the areas of 100-year floodplains that are determined in the FIS by detailed methods. In most instances, BFEs have been derived from detailed hydraulic analyses and are shown within this zone.

Zone AH – Corresponds to the areas of 100-year shallow flooding with a constant water-surface elevation. Flood depths of 1 to 3 feet (usually areas of ponding); BFEs are derived from detailed hydraulic analyses and are shown at selected intervals within this zone.

Zone AO – Corresponds to the areas of 100-year shallow flooding. Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

Zone AR – Depicts areas protected from flood hazards by flood control structures such as levees that are being restored.

Zone D – Depicts undetermined areas but possible flood hazards.

Zone X (dotted) – Other flood areas. Areas of 0.2 percent annual chance flood; areas of 1 percent annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1 percent annual chance flood.

Zone X – Areas determined to be outside the 0.2 percent annual chance floodplain.

The project is shown in FEMA Flood Insurance Rate Map (FIRM) panels 6059C0286J, 060590287J, 06059C0291J, 06059C0292J, 06059C0294J, and 06059C0313J. As shown in Figure 2.2.1-1, Lane Channel, San Diego Creek Channel (Reach 1 – crossing west of Harvard Avenue and Reach 2 – crossing east of I-405/SR-133 interchange), Culver Storm Channel, and San Joaquin Channel (crossing east of Harvard Avenue and west of Jeffrey Road/University Drive) are the only water bodies designated as flood hazard areas (Zones A and AE) within and/or adjacent to the project limits and are further described below.

Lane Channel: Lane Channel is shown in FIRMs 06059C0286J and 06059C0287J, and it is designated as Zone A. The 100-year flood discharge is noted to be contained within the channel.

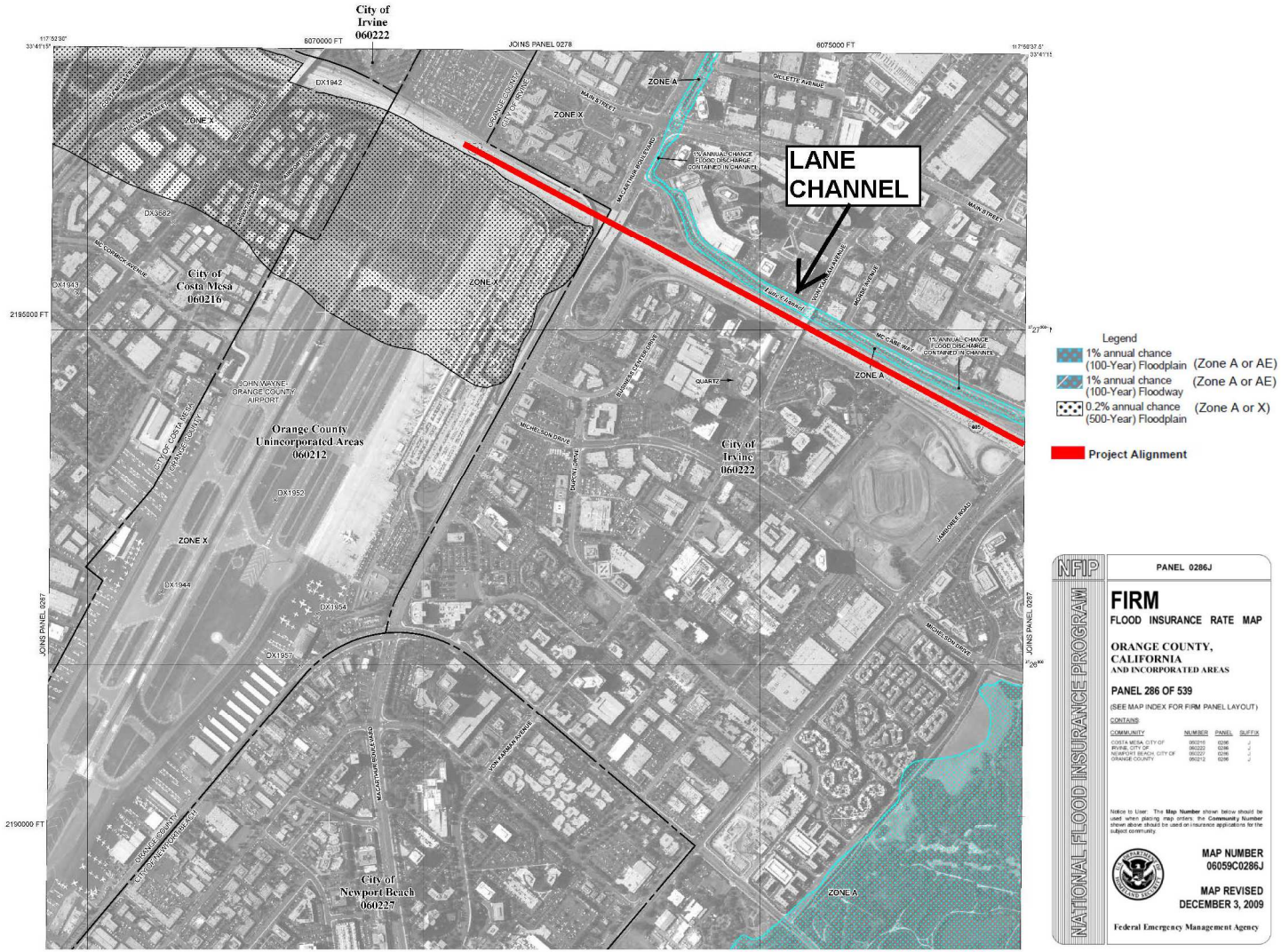

Figure 2.2.1-1. Floodplains within Study Area (Sheet 1 of 6)

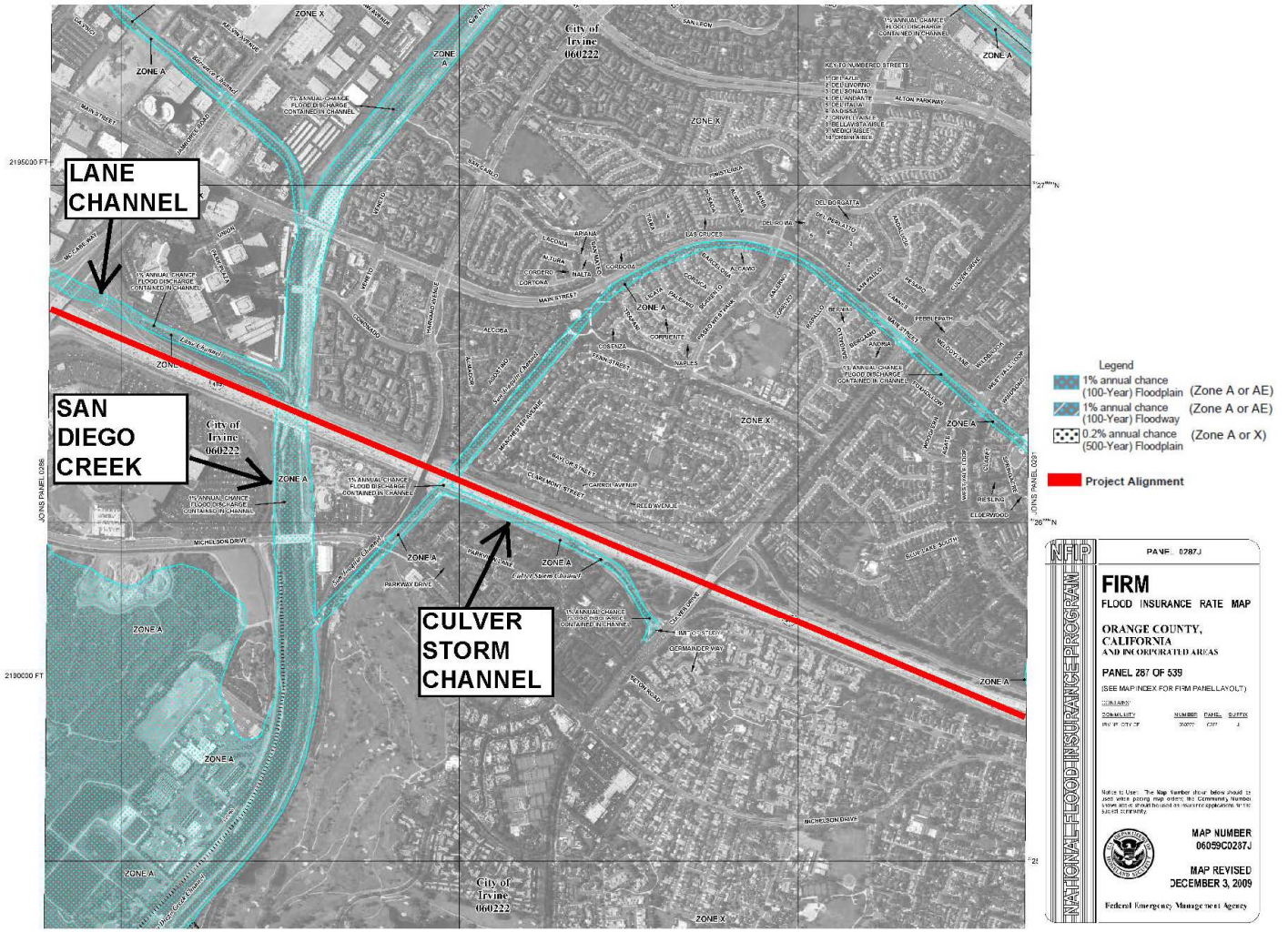

Figure 2.2.1-1. Floodplains within Study Area (Sheet 2 of 6)

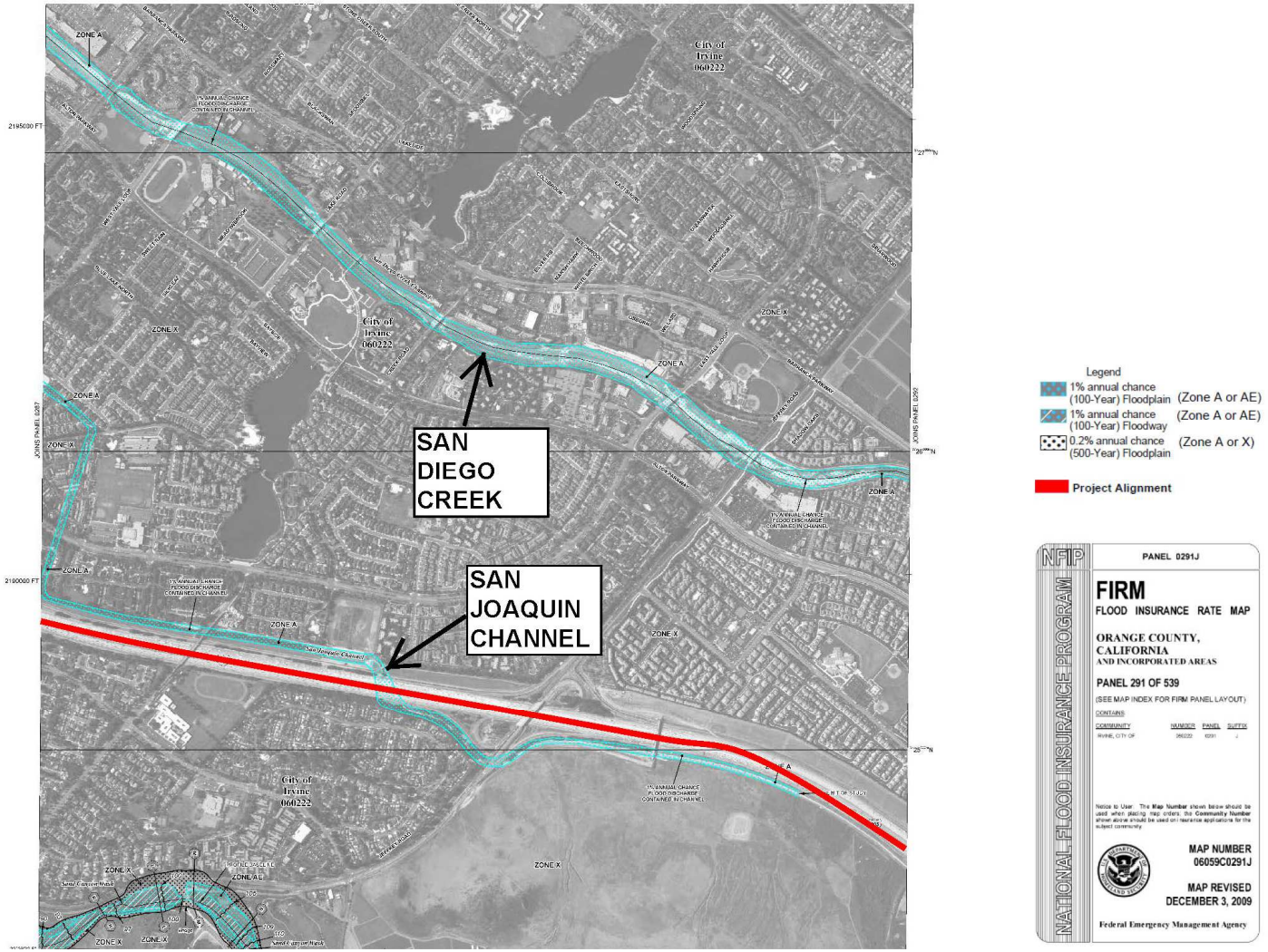

Figure 2.2.1-1. Floodplains within Study Area (Sheet 3 of 6)

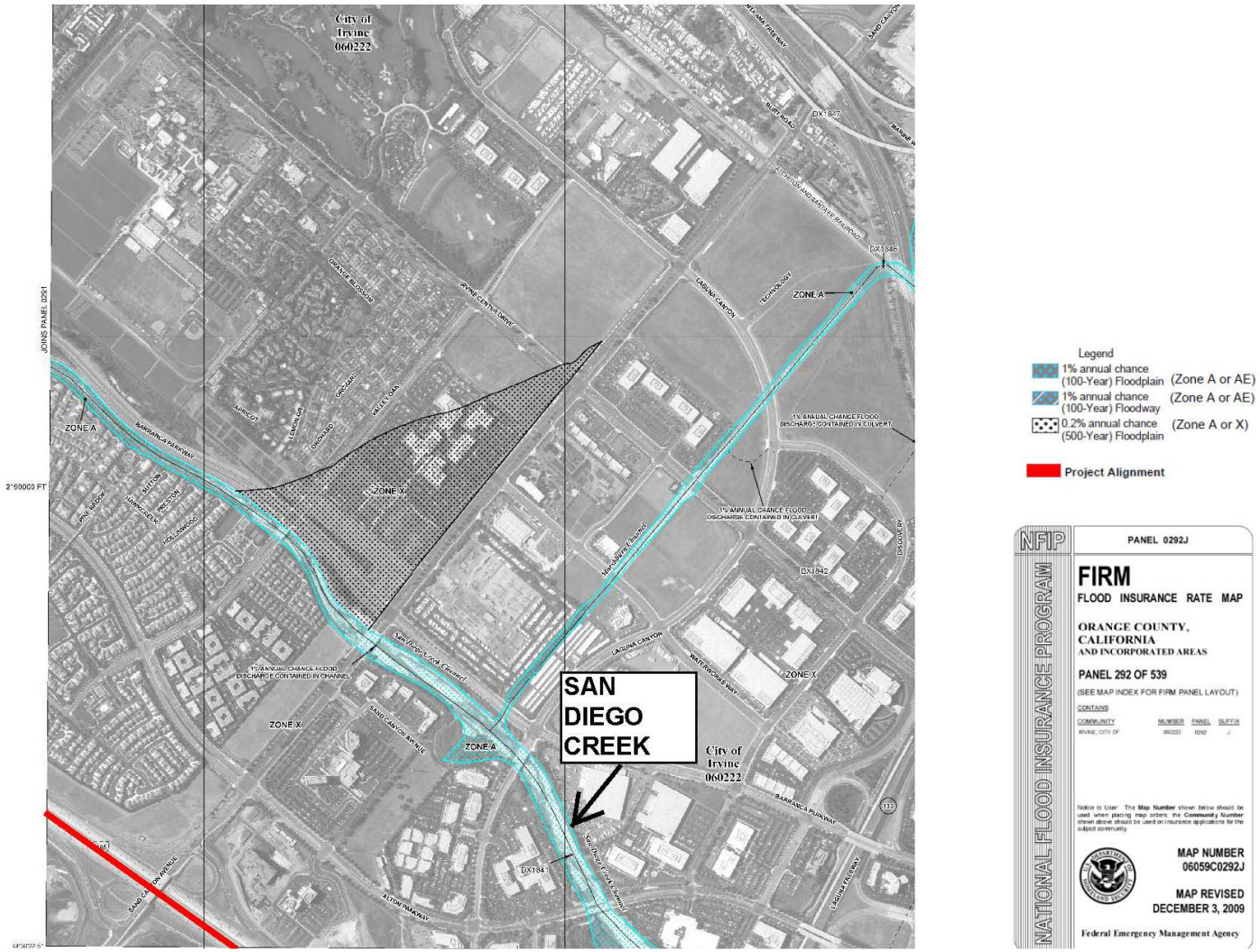

Figure 2.2.1-1. Floodplains within Study Area (Sheet 4 of 6)

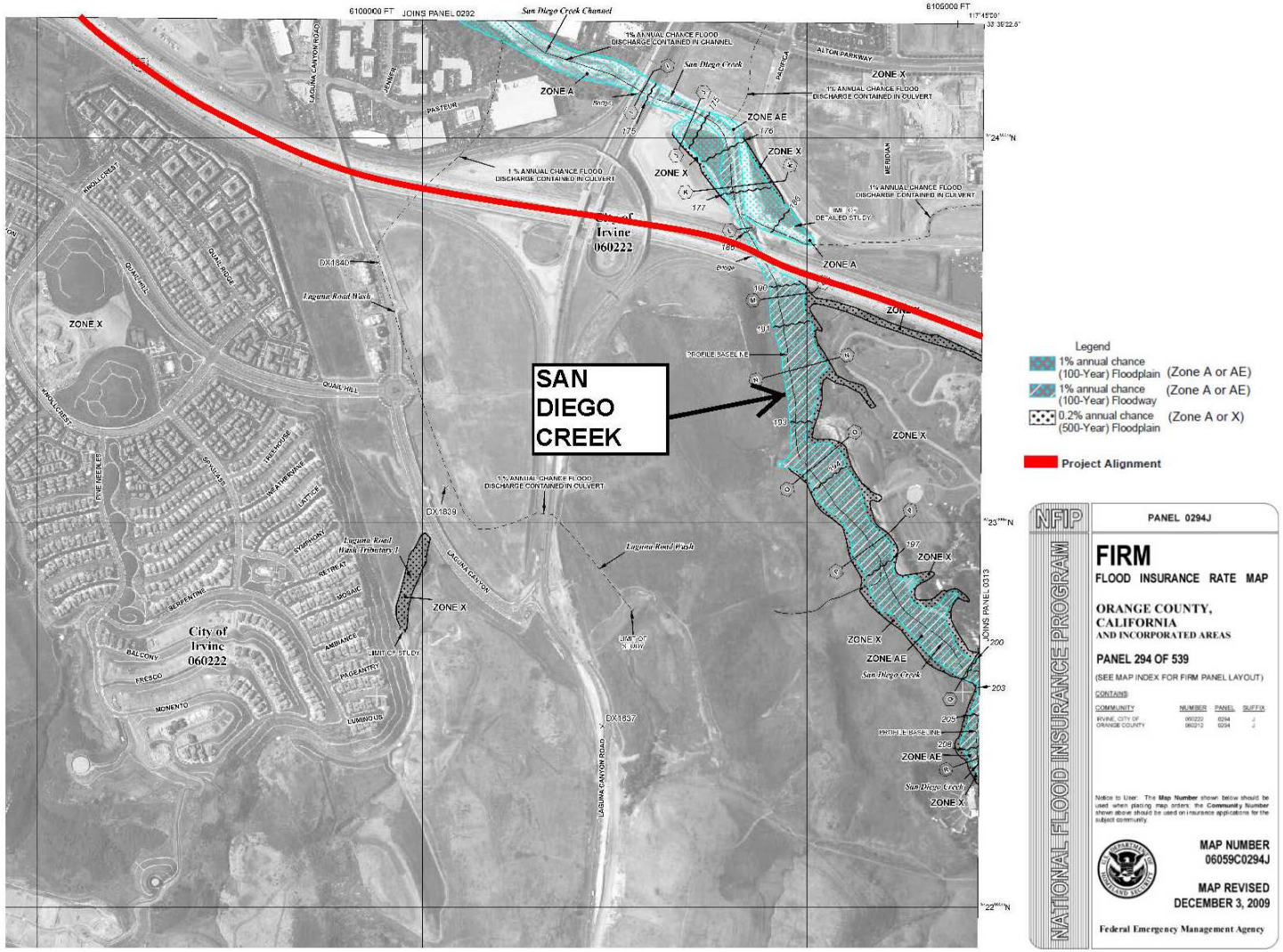

Figure 2.2.1-1. Floodplains within Study Area (Sheet 5 of 6)

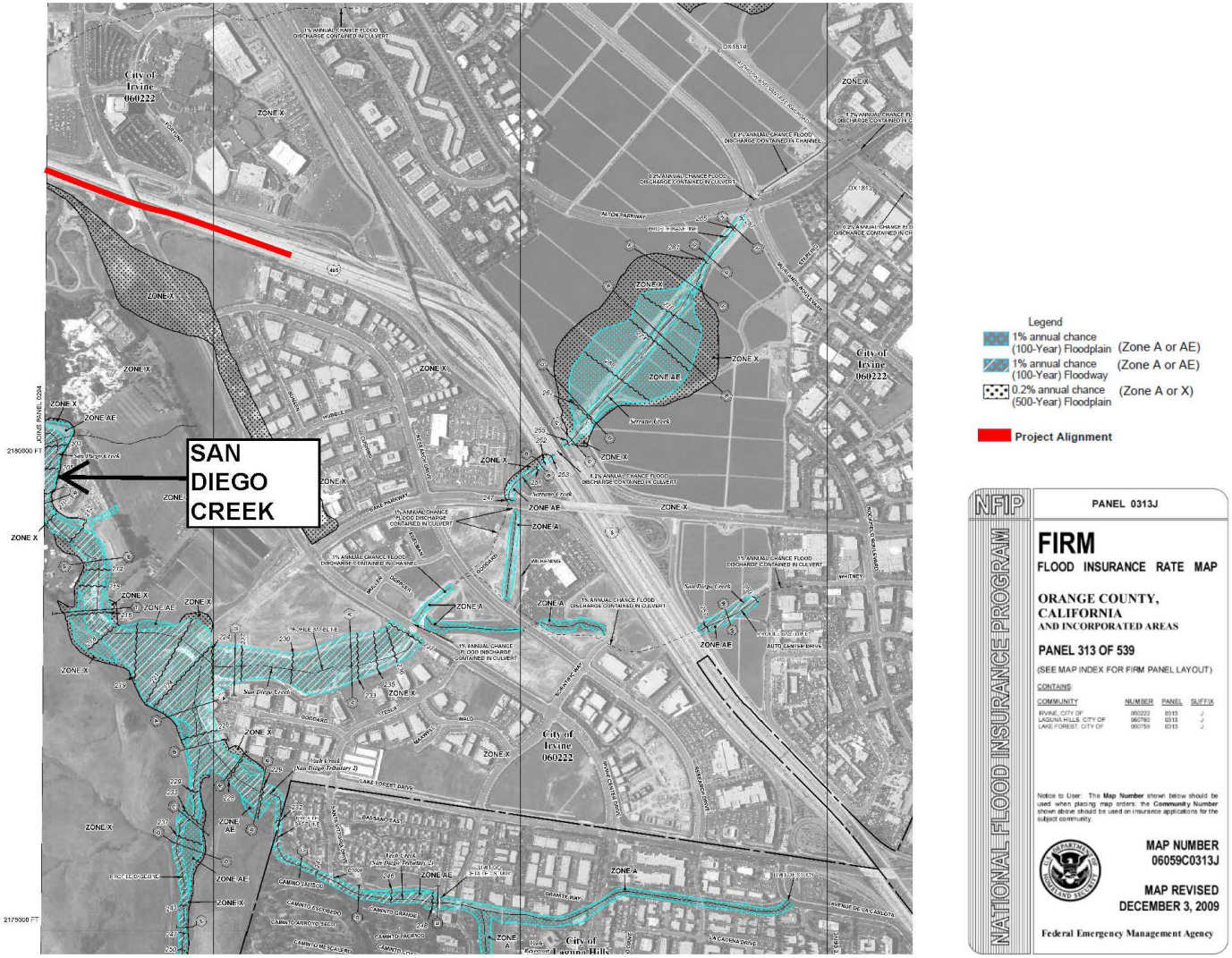

Figure 2.2.1-1. Floodplains within Study Area (Sheet 6 of 6)

San Diego Creek Channel (Reach 1 – crossing west of Harvard Avenue): The San Diego Creek Channel crossing west of the Harvard Avenue OC is shown in FIRM 06059C0287J (December 3, 2009). It is designated as Zone A, with the 100-year flood discharge contained within the channel.

Culver Storm Channel: The Culver Storm Channel is shown in FIRM 06059C0287J (December 3, 2009) and is designated as Zone A. The 100-year flood discharge is contained within the channel.

San Joaquin Channel (crossing east of Harvard Avenue): The San Joaquin Channel crossing I-405 east of Harvard Avenue is designated as Zone A at this location, as shown in FIRM 06059C0287J (December 3, 2009). The 100-year flood discharge is also contained within the channel.

San Joaquin Channel (crossing west of Jeffrey Road/University Drive): The San Joaquin Channel crossing I-405 west of Jeffrey Road/University Drive is designated as Zone A at this location, as shown in FIRM 06059C0291J (December 3, 2009). It is also noted that the 100-year flood discharge is contained within the channel.

San Diego Creek Channel (Reach 2 – crossing east of I-405/SR-133 Interchange): The San Diego Creek Channel crossing east of the I-405/SR-133 interchange is shown in FIRM 06059C0294J (November 7, 2012). The creek is designated as Zone AE (dotted) at this location, with adjacent areas of Zone A (dotted) and Zone X (dotted). The BFE immediately upstream and downstream of the I-405 crossing is 188 feet. It is designated as Zone X (dotted) along SB I-405 between San Diego Creek and Irvine Center Drive. Downstream of the creek's crossing with SR-133, it is designated as Zone A with the 100-year flood discharge contained within the channel.

Existing Drainage Conditions

The existing offsite drainage pattern in the vicinity of the project area generally flows east to west and north to south, discharging to Upper Newport Bay and ultimately the Pacific Ocean. Major crossings are conveyed under I-405 via bridge structures or drainage culverts. Runoff that sheet flows towards I-405 is generally collected by parallel channels or local drainage systems and directed to surrounding cross drainage systems.

The project corridor falls within the San Diego Creek Watershed, which is part of the Lower Santa Ana River Hydrologic Area and East Coastal Plain Hydrologic Sub-Area (801.11).

Within this watershed, the project crosses four water bodies, which are Lane Channel, San Diego Creek Reaches 1 and 2, and San Joaquin Channel.

Onsite Drainage System

The onsite drainage system utilizes a combination of open channel flows via ditches and swales, inlets, and storm drain systems to capture and convey storm runoff away from the roadway. Roadway embankment runoff is typically collected by onsite ditches or channels. Other onsite facilities include water-carrying barriers, down drains, and median inlets. Ultimately, onsite flows drain to a larger flood control facility.

Offsite Drainage System

Major offsite flood control facilities along the project corridor are owned and maintained by the Orange County Flood Control District (OCFCD) or the City of Irvine and are further described below from west to east. In addition, there are several minor culvert and storm drain crossings.

Lane Channel – The Lane Channel is an open channel that runs parallel to NB I-405 between MacArthur Boulevard and the San Diego Creek. It crosses the Jamboree Road on- and off-ramps via a triple 12- by 12-foot reinforced concrete box (RCB), which conveys runoff from east to west where it discharges to the San Diego Creek.

San Diego Creek Channel (Reach 1) – The San Diego Creek Channel crossing (Reach 1) traverses under I-405 approximately 1,400 feet west of Harvard Avenue and 2,500 feet east of Jamboree Road via a bridge structure. The channel flows north to south, conveying stormwater runoff towards the Upper Newport Bay. The existing facility under I-405 is a natural-lined trapezoidal channel with concrete-lined side slopes.

San Joaquin Channel (crossing east of Harvard Avenue) – The San Joaquin Channel crosses I-405 approximately 300 feet east of the Harvard Avenue OC via a triple 12- by 9-foot RCB, conveying stormwater from north to south. Runoff continues to flow southwesterly where it merges with San Diego Creek.

Culver Storm Channel – The Culver Storm Channel conveys runoff along SB I-405 from east to west, where it crosses under Culver Drive via a 5- by 5-foot RCB. This culvert discharges to a concrete trapezoidal channel, which then continues to convey stormwater 2,500 feet westerly to the San Joaquin Channel, where it converges downstream of the I-405 crossing.

San Joaquin Channel (crossing west of Jeffrey Road/University Drive) – The San Joaquin Channel crosses under I-405 via a triple 10- by 7-foot RCB approximately 1,500 feet west of the Jeffrey Road/University Drive OC, conveying flows from south to north. The channel discharges to Retarding Basins 1 and 2 immediately downstream of the I-405 crossing, then conveys flows west within a concrete trapezoidal channel, turns northerly, and traverses through residential developments via storm drain systems.

San Joaquin Channel (between University Drive and Sand Canyon Avenue) – The San Joaquin Channel is an open concrete trapezoidal channel that runs parallel to the SB lanes of I-405 from Sand Canyon Avenue to University Drive, conveying runoff from east to west. The San Joaquin Channel crossing under University Drive is a double 10- by 8-foot RCB. The San Joaquin Channel also traverses I-405 west of the Jeffrey Road/University Drive OC and east of the Harvard Avenue OC. There are two retarding facilities adjacent to the project corridor between Sand Canyon Avenue and Yale Avenue – the San Joaquin West Basin and the combined San Joaquin Basins 1 and 2.

Channel F05S03 – Channel F05S03 crosses I-405 approximately 1,200 feet west of the I-405/SR-133 interchange via double 12- by 6-foot RCBs, conveying runoff in a southwesterly to northeasterly direction.

San Diego Creek Channel (Reach 2) – The San Diego Creek Channel crossing (Reach 2) is located approximately 1,650 feet east of the I-405/SR-133 interchange. The channel conveys offsite stormwater runoff under I-405 from south to north via a bridge structure. The existing facility under I-405 is a concrete-lined trapezoidal channel.

2.2.1.3 Environmental Consequences

Alternative 1 (No Build)

Under the No Build Alternative, the project improvements would not be constructed; therefore, the No Build Alternative would not result in short-term or long-term direct or indirect adverse impacts related to hydrology or floodplains.

Build Alternative 2 (Preferred Alternative) and Build Alternative 3

Hydraulic Methodology

Drainage basins within the project limits of the I-405 ROW were delineated based on existing inlet locations and elevation contours. Hydrology maps were created to depict the drainage basin boundaries, basin names, basin acreages, direction of runoff, and existing conveyance facilities. This information was then used to analyze the onsite existing storm drain facilities

and the hydraulic properties of the project improvements (e.g., new paved median shoulder capacities).

The overall drainage condition concept for Alternatives 2 and 3 would remain similar to the existing drainage condition with respect to direction of flow and ultimate conveyance facilities; however, there are several project changes that would alter the method by which stormwater would be conveyed. Alternatives 2 and 3 would construct lanes in the primarily unpaved median. This would cause an increase in net impervious surface area within the project limits and would increase surface runoff. It is anticipated that existing inlets would have to be upgraded to accommodate higher discharges. The roadway widening would also require relocation of existing inlets to the new edge of pavement. If feasible, storm drain laterals would be protected in place to prevent unnecessary pavement cuts. Capping the existing inlets can be an alternative to complete removal and/or reconstruction. It may also be necessary to retrofit onsite systems to convey flows to Permanent BMP locations.

Alternatives 2 and 3 would require improvements to existing flood control facilities, including several culverts that would need to be extended to accommodate the roadway widening. In addition, Alternatives 2 and 3 would require floodplain encroachments on the San Diego Creek Channel to accommodate the widening of Bridge No. 55-0285 at Reach 1 and Bridge No. 55-0451 at Reach 2. Table 2.2.1-1 summarizes the proposed improvements to existing flood control facilities and bridges under Alternatives 2 and 3.

Table 2.2.1-1. Proposed Improvements to Existing Flood Control Facilities and Bridges

Channel Name	Approximate Location	Type of Existing Facility	Alternative 2 (Preferred Alternative) Proposed Improvements	Alternative 3 Proposed Improvements
Airport Storm Channel	I-405 SB, between 550 feet west of Red Hill Avenue and 950 feet east of Red Hill Avenue	12' x 8' Rectangular Channel	Protect in place.	Protect in place.
Unnamed	I-405, 500 feet west of Von Karman Avenue	6' x 6' RCB	Protect in place.	Protect in place.
Unnamed	I-405, 1,400 feet west of Jamboree Road	8' x 10' RCB	Protect in place.	Protect in place.
Lane Channel	I-405 at Jamboree Road	Triple 12' x 12' RCB	Culvert extensions and inlet/outlet headwall modifications may be required.	Culvert extensions and inlet/outlet headwall modifications may be required.

Table 2.2.1-1. Proposed Improvements to Existing Flood Control Facilities and Bridges

Channel Name	Approximate Location	Type of Existing Facility	Alternative 2 (Preferred Alternative) Proposed Improvements	Alternative 3 Proposed Improvements
San Diego Creek Channel (Reach 1)	I-405, 1,400 feet west of Harvard Avenue	Bridge crossing Br No. 55-0285 R/L	Bridge widening along NB I-405 (upstream end).	Bridge widening along NB I-405 (upstream end).
San Joaquin Channel	I-405, 300 feet east of Harvard Avenue	Triple 12' x 9' RCB	Protect in place.	Extend culvert at the upstream end and possibly on the downstream end as well. Modify inlet and outlet headwalls.
Culver Storm Channel	I-405 at Culver Drive	5' x 5' RCB	Extend culvert at the upstream end and modify inlet headwall.	Extend culvert at the upstream end and modify inlet headwall.
San Joaquin Channel	I-405, 1,500 feet west of Jeffrey Road/University Drive	Triple 10' x 7' RCB	Culvert extensions and inlet/outlet modifications may be required.	Culvert extensions and inlet/outlet modifications may be required.
San Joaquin Channel	I-405 SB, between University Drive and Sand Canyon Avenue	Double 10' x 8' RCB	Protect in place.	Protect in place.
Channel F05S03	I-405, 1,200 feet west of I-405/SR-133 interchange	Double 12' x 6' RCB	Remove and replace approximately 110 feet of RCB due to increased cover.	Remove and replace approximately 110 feet of RCB due to increased cover.
San Diego Creek Channel (Reach 2)	I-405, 1,650 feet east of I-405/SR-133 Interchange	Bridge crossing Br No. 55-0451 L/R	Bridge widening along NB I-405 (downstream end).	Bridge widening along NB I-405 (downstream end).

The project crosses or is directly adjacent to six FEMA 100-year floodplains. The project would only be constructed within the following five 100-year floodplains where improvements would be needed, as described in Table 2.2.1-1: Lane Channel, Culver Storm Channel, San Joaquin Channel (crossing east of Harvard Avenue), and San Diego Creek Channel Reach 1 (crossing west of Harvard Avenue) and Reach 2 (crossing east of I-405/ SR-133 interchange).

Preliminary hydraulic modeling has been completed for the project at the San Diego Creek Channel Reach 1 and Reach 2 where the existing bridge crossing over the channel would be widened on the upstream end at Reach 1 and the downstream end at Reach 2 to accommodate

the proposed roadway. Based on the hydraulic modeling, the proposed bridge widening and associated pier and abutment extensions would not significantly impact the bridge's efficiency to convey the 100-year design stormwater runoff. The proposed work would also result in a negligible increase to water surface elevations and velocities.

Based on these conditions, changes to the base (100-year) floodplain are anticipated to be minimal due to the project improvements. Alternatives 2 and 3 include improvements to an existing highway that would not redirect or impede flood flows. The build alternatives would not generate substantial quantities of runoff that could create a flood hazard or that could cause a substantial increase in the potential for people to be impacted by a flood event. No direct or indirect adverse long-term impacts are anticipated related to risk to life or property, impacts on natural and beneficial floodplain values, or impacts on floodplain encroachment. The build alternatives are not anticipated to result in permanent adverse impacts on the 100-year floodplains.

The Preliminary Drainage Report (2015) provided conceptual analysis of the proposed onsite drainage improvements associated with the project. Additional detailed drainage analysis would occur and a Final Drainage Report would be prepared during final design, based on an updated hydraulic model. In addition, a detailed survey of the existing hydrological features to determine actual as-built conditions would be performed. The results of the survey would be incorporated into an updated hydraulic model for both existing and project conditions. Any drainage deficiencies identified in the Final Drainage Report would be addressed through design adjustments. With adherence to these standard Caltrans practices during final design, no direct or indirect adverse long-term impacts to hydrology or floodplains would result from the build alternatives. There would be no significant floodplain encroachments.

Coordination with OCFCD, USACE, Caltrans, CDFW, Santa Ana RWQCB, and/or the cities of Irvine and Costa Mesa would be required for impacts to existing drainages, flood control facilities, and the bridge crossings. In addition, the following permits are likely to be required for the proposed project: encroachment permit from OCFCD, Section 404 Permit from USACE, Section 401 Permit from the Santa Ana RWQCB, 1602 Streambed Alteration Agreement from CDFW, and National Pollutant Discharge Elimination System (NPDES) permits.

Construction (Short-Term) Impacts

With the implementation of water quality BMPs as described in the *Caltrans Storm Water Quality Handbook* and the *Construction Site Best Management Practices Manual*, including soil stabilization, flow conveyance control, and sediment control, surface runoff water quality

impacts during construction would be minimized. Short-term floodplain encroachments are expected as a result of the project construction activities. Coordination with OCFCD, USACE, Caltrans, and the cities of Irvine and Costa Mesa will be conducted throughout the duration of the project. Therefore, no direct or indirect adverse short-term impacts would occur from construction of the build alternatives.

2.2.1.4 Avoidance, Minimization, and/or Mitigation Measures

With adherence to Caltrans standard design and construction practices, which are required on all State Highway System projects, impacts related to hydrology or floodplains will be avoided or minimized. No additional measures are required.